

According to the method of the present invention, subsequent to the production of the "green foam" as just described, the "green foam" may be subjected to carbonization and graphitization within the controlled conditions described below to obtain activated foams that exhibit specific thermal or electrical conductivity or insulating properties or strengths for specific applications.

Carbonization, sometimes referred to as calcining, is conventionally performed by heating the green foam under an appropriate inert gas at a heat-up rate of less than about 5° C per minute to a temperature of between about 600°C and about 1600°C and preferably between about 800° C and about 1200° C and soaking for from about 1 hour to about three or more hours. Appropriate inert gases are those described above that are tolerant of these high temperatures. The inert atmosphere is supplied at a pressure of from about 0 psi up to a few atmospheres. The carbonization/calcination process serves to remove substantially all of the non-carbon elements present in the green foam such as sulfur, oxygen, hydrogen, etc.

Graphitization, commonly involves heating the carbon foam either before or after carbonization at heat-up rate of less than about 10° C per minute, preferably from about 1° C to about 5° C per minute, to a temperature of between about 1700° C and about 3000° C in an atmosphere of helium or argon and soaking for a period of less than about one hour. Again, the inert gas may be supplied at a pressure ranging from about 0 psi up to a few atmospheres. According to a preferred

embodiment of the process described herein, the activated foams of the present invention are produced by sequentially carbonizing and then graphitizing the green foam as described above.

5                   Activation of the coal-based carbon foams prepared as described hereinabove is achieved by flowing carbon dioxide or ozone through the carbon foam, "green" foam, calcined foam or graphitized foam, at elevated temperature to partially oxidize and pit the carbon foam. The activation process involves placing the carbon foam into a heated container and flowing the oxidative gas, for example  
10   CO<sub>2</sub> or ozone through the carbon foam at elevated temperature for a period of time adequate to obtain the required oxidation/ pitting. Specific operative processing conditions include but are not limited to gas flow rates on the order of from about 1 to about 10 cubic feet per minute for a period of from about 1 to about 12 hours at a temperature of between about 600° C and about 1200° C. Depending upon the level  
15   of activation desired, these operating parameters can be varied broadly to obtain activated foams of varying levels of activation. As shown in example 1 below, specifically preferred operating ranges include gas flow rates on the order of 4 to 5 cubic feet per minute after an initial purge at a temperature of between about 800° C and about 1200° C for a period of between about 2 and about 6 hours. As will be  
20   apparent to the skilled artisan, the level of "activation" i. e. increase in overall surface area will be dependent upon the duration of the activation process as well as the temperature at which the activation is performed and the oxidative potential of the activating agent, CO<sub>2</sub> or ozone. It has generally been found that treatments that

do not adversely affect the carbon foam or its structure yield activated foams demonstrating overall surface areas in the range of between about 10 m<sup>2</sup>/g and about 25 m<sup>2</sup>/g. A preferred overall surface area is between about 15 m<sup>2</sup>/g and about 20 m<sup>2</sup>/g.

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The following example will serve to better illustrate the successful practice of the invention.

### Examples

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A laboratory scale activation cell was made from 3 inch inside diameter pipe, end caps and tube fittings (to provide gas access to the interior of the cell) – all fabricated from 304 stainless steel. The cell was situated vertically in a Harper SiC heating element furnace on a firebrick pedestal. Carbonized coal-based carbon foam samples 3.0 inches in diameter and 0.5 inches in thickness were loaded into the cell and separated by 304 stainless steel folded expanded metal standoffs. The foam samples were made from Powellton bituminous coal having a bulk density of about 30 pounds per cubic foot and had been prepared as described hereinabove and calcined at 1050° C to remove volatile material therefrom. A plug of very fine (#00) steel wool was placed beneath the lower foam sample and above the upper foam sample to scavenge oxygen in the cell and to prevent over oxidation. The cell was sealed and the 304 stainless steel tubing fed through a sight port in the door of the furnace. A pair of ¼ inch stainless steel tubes were connected via compression